

Taxonomical studies on ovariicolous ustomycetes on Caryophyllaceae I. *Ustilago jehudana* and *Ustilago moenchieae-manticae*

Cvetomir M. Denchev

Institute of Botany, Bulgarian Academy of Sciences, 23 Acad. G. Bonchev Str., 1113 Sofia, Bulgaria

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A study of the type specimen of *Ustilago jehudana* resulted in the correction of the diagnosis. The sori are localized in the host gynoecium but not in the anthers. Morphological characters of the sori and ustospores of the later described *U. moenchieae-manticae* are identical with these of *U. jehudana*. *Ustilago moenchieae-manticae* is reduced here to a synonym of *U. jehudana*. The smut is reported as new to Bulgaria on a new host, viz., *Moenchia erecta*. A new combination, *Bauhinus jehudanus*, is proposed.

Key Words—*Bauhinus*; *Microbotryum*; taxonomy; *Ustilago*; ustomycetes.

In the course of a world revision of *Microbotryum* on Caryophyllaceae, *Ustilago jehudana* Zundel was studied. Zundel (1944) described this species from the anthers of *Silene apetala* Willd.: "Sori destroying the anthers, spore-mass powdery, dark brown; spores globose to subglobose, regular, dark orange-brown, chiefly 10.5 to 14 μm diameter, reticulate." Durrieu and Zambettakis (1973), investigating *Ustilago* on Caryophyllaceae, noted: "Des espèces localisées sur les anthères, on peut séparer *U. jehudana*, dont les spores sont les plus grandes, 11 à 14 μm au lieu de 5 à 11 μm , mais pour lequel nous n'avons pu obtenir de matériel." Deml and Oberwinkler (1982) reinstated the genus *Microbotryum* for the anthericolous smut fungi on Caryophyllaceae. *Ustilago jehudana* was presumed to be a member of *Microbotryum*, and one objective of the present study was to examine this attribution.

Materials and Methods

Specimens of *Ustilago jehudana* and *Ustilago moenchieae-manticae* Lindtner from BPI, HUV and SOM were investigated. In each collection, 100 ustospores were measured in lactophenol (heated to boiling, then cooled) by oil immersion at a magnification of 1,250 \times . The colour of the spore mass and ustospores are in accordance with Rayner (1970). The ornamentation of ustospores was observed and photographed with a JEOL JSM Scanning Electron Microscope (SEM). A linear graphic presentation of the statistical parameters was used. The samples are not discrete, and the variability is continuous if there is graphic overlapping in the $\bar{x} \pm \text{S.D.}$ areas with respect to the character investigated. On the basis of the variation coefficients (V), the following scale for evaluating the metric variability of the ustospores was used:

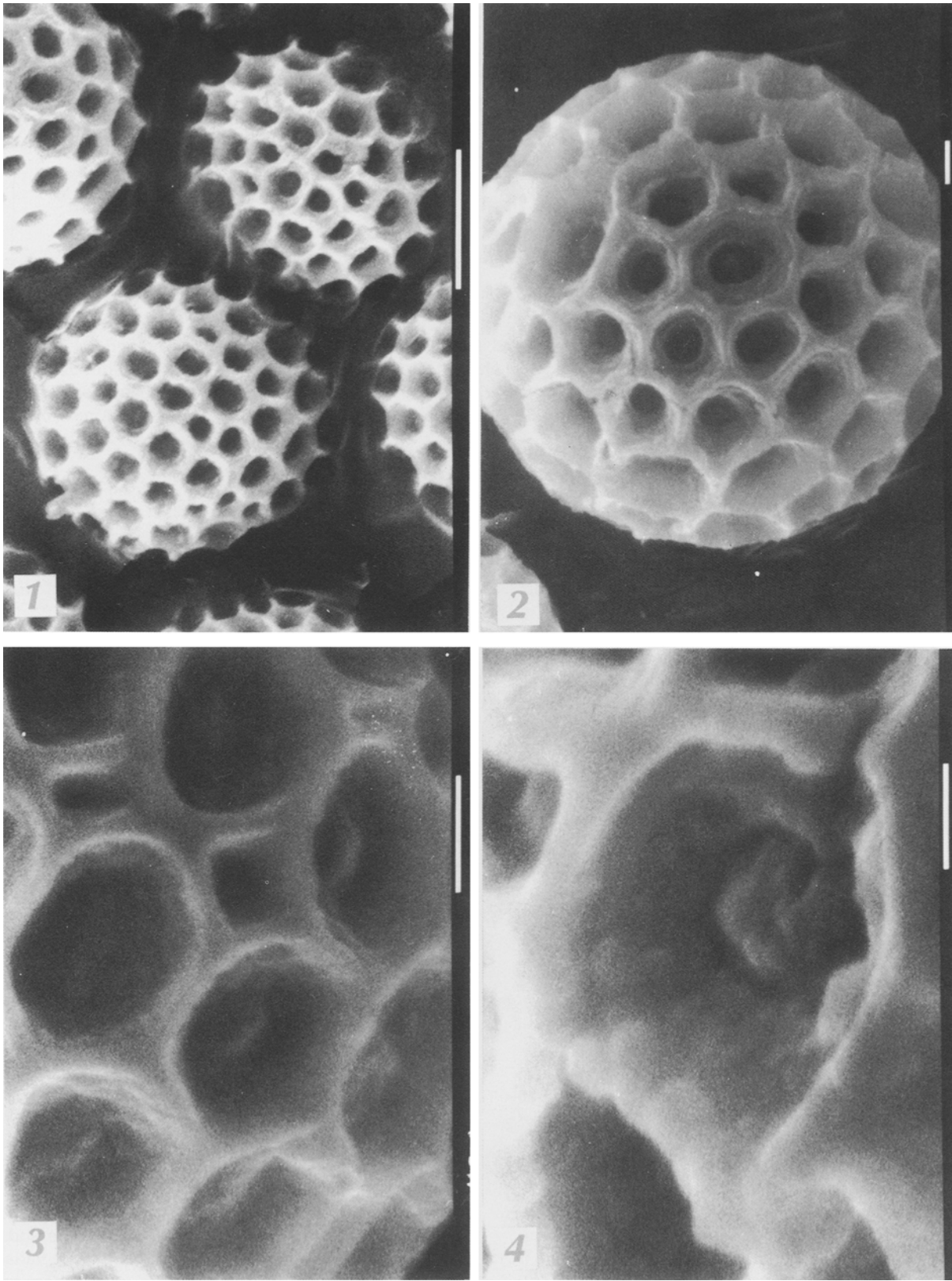
reduced degree ($V \leq 5\%$), modal level ($V = 5.1-10\%$), increased degree ($V = 10.1-15\%$) and high degree ($V = 15.1-30\%$) (Denchev, 1993, 1995).

Results and Discussion

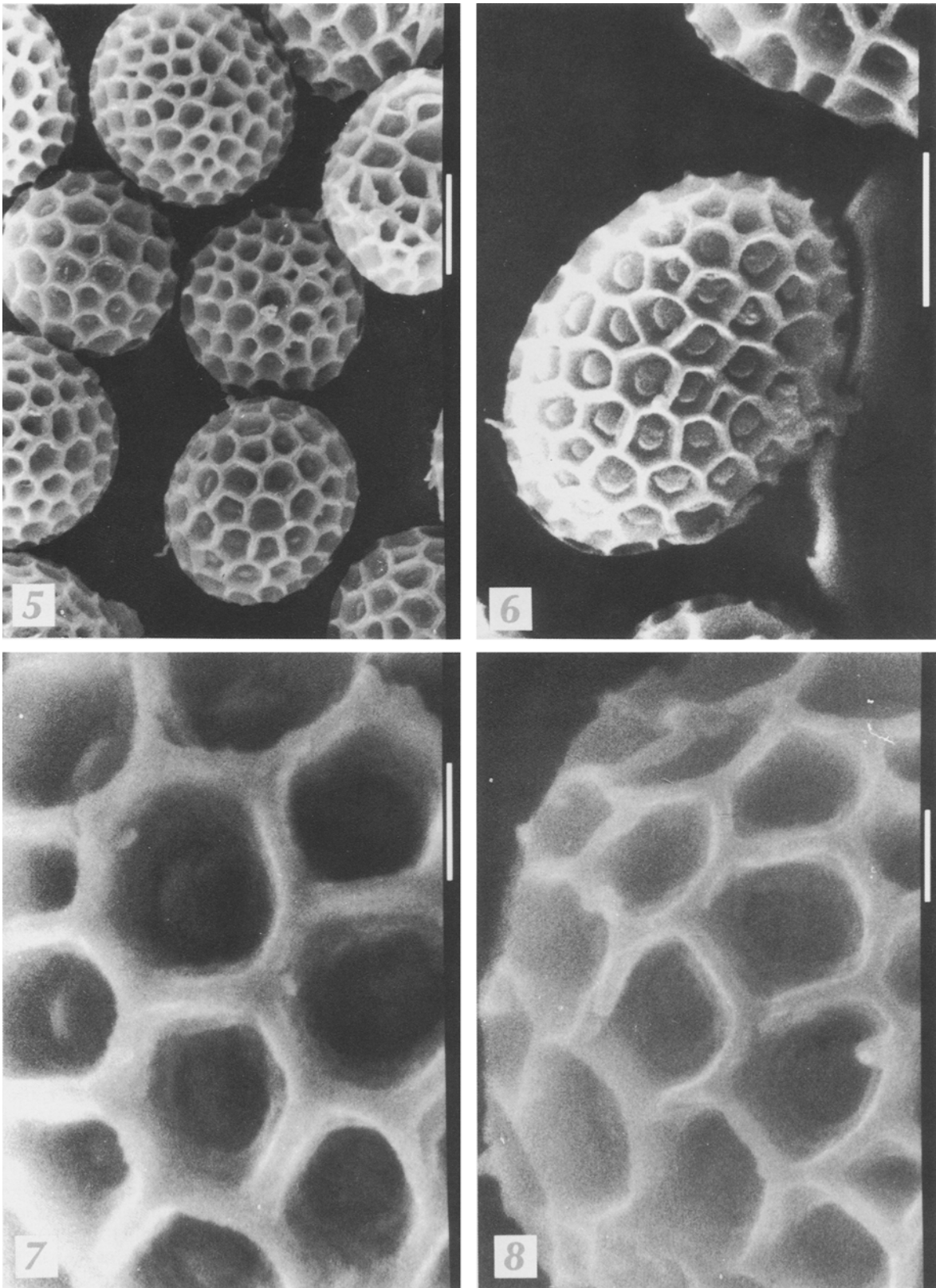
The localization of the sori is not a morphological fungus character but it has a taxonomic value. The ustomycetes in the reproductive organs of Caryophyllaceae are divided into three groups: having sori in the anthers, in the ovaries (later filling the capsules with spore mass) or in all fertile floral parts (the androecium and gynoecium). In the protologue of *U. jehudana*, Zundel (1944) defined the localization of the sori in the anthers. The revision of the type, however, showed that it was a non-anthericolous ustomycete. The sori of *U. jehudana* are localized in the host gynoecium, destroying the ovules. This smut fungus is known only from the type collection (Palestine, Desert of Jehuda).

A SEM study of the exospore ornamentation showed \pm presence of a hemispherical protuberance on the bottom of the meshes (Figs. 1–4). This is one of the characteristic features of another smut fungus in ovules of Caryophyllaceae, namely *U. moenchieae-manticae* (Figs. 5–10). A critical comparative examination of six specimens, including the lectotype, revealed the identity of *U. jehudana*. The minimum, maximum and $\bar{x} \pm \text{S.D.}$ values of the ustospore length and width of both species, as well as the values of the other investigated quantitative and qualitative characters, are not discrete and the variability is continuous (Table 1, Fig. 11). The variability of the ustospore length and width of all investigated specimens of both species is at a modal level (Table 1).

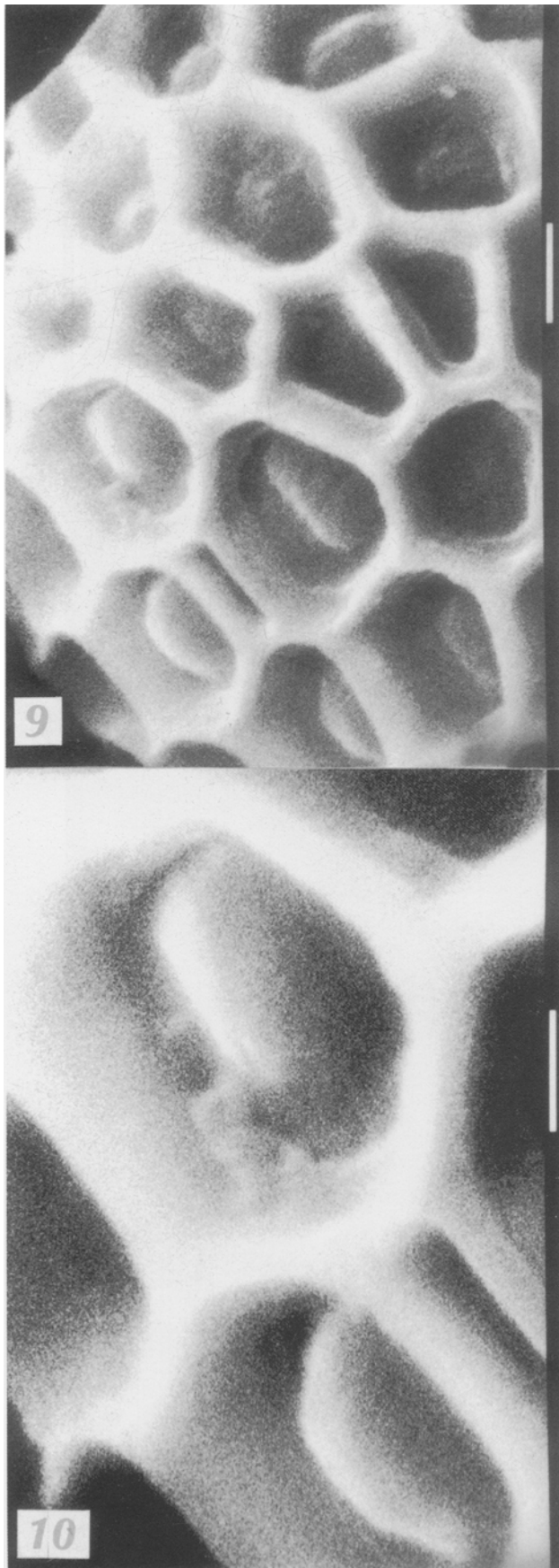
According to Zundel (1944) the colour of the spores of *U. jehudana* is dark orange-brown ('atro-croceo-brun-



Figs. 1-4. Scanning electron micrographs of ustospores of *Bauhinus jehudanus* (holotype).
Scale bars: 1=5 μm, 2, 3=1 μm, 4=0.5 μm.



Figs. 5–8. Scanning electron micrographs of ustospores of *Bauhinus jehudanus* on *Moenchia mantica*.
 5, 7. Vánky, Ust., No. 82. 6. Lectotype of *Ustilago moenchiae-manticae*, HUV 4123. 8. Fl. Olt. exs., No. 161. Scale bars: 5, 6 = 5 μm , 7, 8 = 1 μm .



neis'), while according to Lindtner (1950) the colour of the spore wall of *U. moenchiae-manticae* is 'carneo-brunnea.' The colour of the ustospore wall and its ornaments is difficult to name: the colour under a low LM magnification differs from that under a high (more than $800\times$) LM magnification. Under a low LM magnification it is possible to evaluate only generally the colour of the spore: livid vinaceous (83), vinaceous (57), brick (59), livid red (56) or pale vinaceous (85) of *U. jehudana*, and livid vinaceous, vinaceous or pale vinaceous of *U. moenchiae-manticae*. Under a high LM magnification the colours of the muri and the bottom of the meshes of *U. jehudana* (1) and *U. moenchiae-manticae* (2) are: (1) muri livid purple (81), the bottom of the meshes fawn (87), hazel (88) or honey (64); and (2) muri livid purple, the bottom of the meshes honey or hazel.

Ustilago moenchiae-manticae is treated here as a synonym of *U. jehudana*. This taxon is a new species to Bulgarian smut fungi.

Recently Moore (1992) proposed the new genus *Bauhinus* for all dicot smuts of *Ustilago*. Vánky (1993) reduced *Bauhinus* to a synonym of *Microbotryum*. After dividing *Ustilago* species on dicots between the *Microbotryum* for species on Caryophyllaceae and *Bauhinus* for species on other dicot families (Moore, 1996), the taxonomic scheme of Ustilaginales is altered. The genus *Bauhinus* is in accordance with Article 52.3. of the Tokyo ICBN and becomes correct. The validation of the name *Bauhinus* is discussed in Denchev (1977). The sorus and ustospore morphology of the ovaricolous *Ustilago* species on Caryophyllaceae differ from those of the anthericolous *Ustilago* species on Caryophyllaceae. I treat the species of *Microbotryum* more strictly than Moore (1996), i.e., as limited to anthericolous smuts (Deml and Oberwinkler, 1982; Vánky, 1994). The ovaricolous *Ustilago* species on Caryophyllaceae must be included in *Bauhinus*. A new combination is proposed here.

Bauhinus jehudanus (Zundel emend. Denchev) Denchev, comb. nov. Figs. 1–10

Basionym: *Ustilago jehudana* Zundel, Mycologia **36**: 401. 1944.

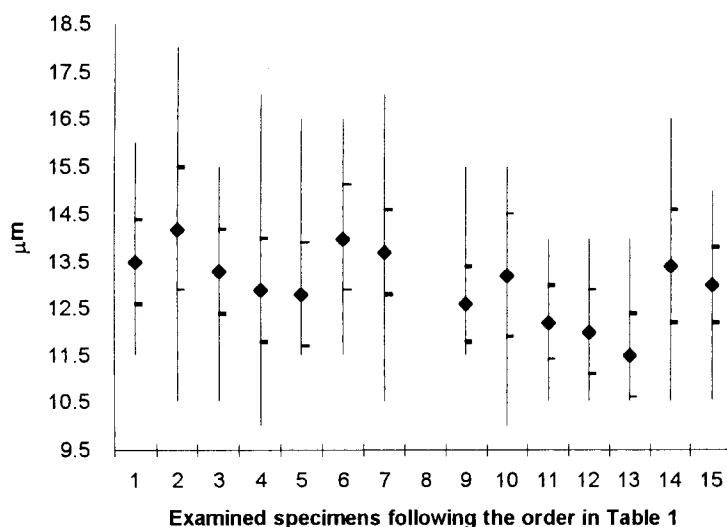
Synonym: *Ustilago moenchiae-manticae* Lindtner, Glasn. Prir. Muz. Srpske Zemlje, Ser. B, Biol. Nauke **3–4**: 32. 1950.

Sori destroying the ovules and filling the capsules with powdery, violet slate (99), purple slate (102), brown vinaceous (84) or dark vinaceous (82) spore mass. Ustospores globose, subglobose or ovoid, rarely broadly ellipsoidal, $10\text{--}18 \times 10\text{--}16.5$ ($\bar{x} \pm \text{S.D.}$: $13.5 \pm 1.0 \times 12.5 \pm 0.9$) μm , $Q = (1.04\text{--})1.07\text{--}(1.11)$, reticulate, muri livid purple, the bottom of the meshes honey, hazel or fawn, (6–) 7–9 (–10) meshes per spore diameter, meshes irregularly (quadri-) pentagonal or hexagonal, (0.8–)1.0–2.4 (–3.4) μm long, muri (0.6–)1.0–1.6 (–2) μm high; in SEM the

Figs. 9, 10. Scanning electron micrographs of ustospores of *Bauhinus jehudanus* on *Moenchia erecta* (SOM 21465-M). Scale bars: 9=1 μm , 10=0.5 μm .

Table 1. Morphometrical variability of the ustospores and colour of the spore mass of *Bauhinus jehudanus* on *Moenchia* spp. and *Silene apetala*.

Host, specimen	Dimension of ustospores (μm)						L/W ratio	Colour of spore mass	Meshes per spore diam	Length of meshes (μm)
	Length			Width						
	min-max	M \pm S.D.	V(%)	min-max	M \pm S.D.	V(%)				
<i>Moenchia erecta</i>										
Bulgaria, SOM 21465-M	11.5–16.0	13.5 \pm 0.9	6.7	11.5–15.5	12.6 \pm 0.8	6.3	1.07	99	(6–)7– 9 (–10)	(0.8–)1 –2 (–3.4)
<i>Moenchia mantica</i>										
Serbia, HUV 4123	10.5–18.0	14.2 \pm 1.3	9.1	10.0–15.5	13.2 \pm 1.3	9.8	1.07	84 or 82	(6–)7–10	(0.8–)1.4–2.5 (–3.4)
Romania, Vanky, Ust. No. 82	10.5–15.5	13.3 \pm 0.9	6.8	10.5–14.0	12.2 \pm 0.8	6.5	1.09	102 or 84	6–10	(0.8–)1 –2 (–2.8)
Romania, HUV 10791	10.0–17.0	12.9 \pm 1.1	8.5	10.5–14.0	12.0 \pm 0.9	7.5	1.07	102 or 99	(6–)7– 9	(0.8–)1.2–2 (–2.8)
Romania, Fl. Olt. exs., No. 161	11.5–16.5	12.8 \pm 1.1	8.6	10.5–14.0	11.5 \pm 0.9	7.8	1.11	99	7–10	(0.8–)1.2–2.4 (–3.2)
Romania, HUV 4124	11.5–16.5	14.0 \pm 1.1	7.9	10.5–16.5	13.4 \pm 1.2	8.9	1.04	102 or 84	7–10	0.8–2
<i>Silene apetala</i>										
Palestine, BPI 188 938	10.5–17.0	13.7 \pm 0.9	6.6	10.5–15.0	13.0 \pm 0.8	6.1	1.05	102 or 84	7– 9	0.8–2.4

Fig. 11. Line diagram for length (1–7) and width (9–15) values of ustospores of *Bauhinus jehudanus*. Vertical bars on the lines show mean \pm S.D. ◆: mean.

meshes often with a hemispherical protuberance on the bottom.

Distribution: on *Moenchia* Ehrh. (SE Europe) and *Silene* L. (SW Asia).

Specimens examined (marked with !) or cited in literature: On *Moenchia erecta* (L.) Gaertn., B. Mey. & Scherb. (matrix nova): Bulgaria, mt. Rhodopy orientalis, prope pagum Mezek, distr. Haskovo, 24.IV.1977, V. Velchev and P. Vasilev (as *Moenchia graeca* Boiss. & Heldr.), SOM 21465-M (!). On *Moenchia mantica* (L.) Bartl. subsp. *mantica*: Romania, Transsilvania, distr. Cluj, Cîmpeni, Lupșa, ad coenobium, 8.VII.1953, A. Negru and V. Soran (as *U. moenichiae-manticae*), HUV 4124 (!);

Oltenia, distr. Baia de Aramă, prope pagum Balta, cca. 700 m s.m., 1.VII.1963, I. Comes, II. Ene and M. Costescu, in Fl. Olt. exs., No. 161 (as *U. moenichiae-manticae*), SOM 15936-M (!); Banatus, distr. Caraș-Severin, ad balneas Hercules, cca. 200 m s.m., 9.VI.1966, K. Vánky, in Vánky, Ust., No. 82 (as *U. moenichiae-manticae*), SOM 18111-M, (!) and Herb. mycol. rom., No. 1969 (as *U. moenichiae-manticae*), HUV 4128 (!); Banatus, distr. Caraș-Severin, ad pedem Mt. Arjana, 45°01' N, 22°24' E, 840 m s.m., 4.VII.1982, G. Negrean (as *U. moenichiae-manticae*), HUV 10791 (!); Serbia, pag. Rudnik prope G. Milanovca, l.d. Ćeramide, 15.VI.1946, V. Lindtner (HUV 4123 (Lectotype of *U. moenichiae-manticae*,

!) and Ust. Jugosl., No. 3 (Isolectotypes of *U. moenchieae-manticae*). Other Serbian specimens (Lindtner (1950), as *U. moenchieae-manticae*): Prope pagum Rudnik, I.d. Ostrovica, 16.VI.1946, V. Lindtner (n.v.); Rid ad Vlasini, 19.VIII.1947, V. Lindtner (n.v.); Pag. Kraljeva, I.d. Vunjačka Livada, 20.VI.1948, V. Lindtner (n.v.); Divčibare ad Maljenu, cca. 1,000 m s.m., 9.VII.1948, V. Lindtner (n.v.). On *Silene apetala* Willd. (nom. cons. prop.), Greuter, (1995): Asia, Palestine, Desert of Jehuda, 25.III.1935, coll. T. Rayss (BPI O 188 938 (Holotype, !), BPI O 162 085 (Isotype, !); on the labels of both specimens as *U. jehudae*).

Morphologically *Bauhinus jehudanus* is very close to *Ustilago duriaeana* Tul. & C. Tul. The whole group of the ovariicolous smuts on Caryophyllaceae needs further investigations.

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